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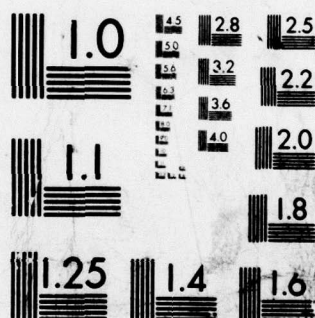


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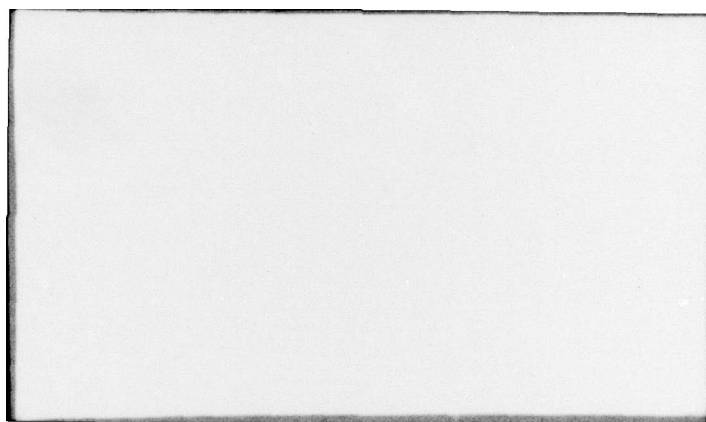
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WOODS HOLE OCEANOGRAPHIC INSTITUTION
Woods Hole, Massachusetts

(14) WHOI-REF-50-31

Reference No. 50-31

(6) OCEANOGRAPHIC RESEARCH.
conducted during the period

April 1, 1950 - June 30, 1950

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APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

(9) Periodic Status Report, No. 16, 1 Apr-30 Jun 50.
Submitted to the Oceanographic Division
Hydrographic Office
Under Contract No. N6onr-277(01)
(NR-083-004)
With Office of Naval Research

(11) August 1950

(12) 13

APPROVED FOR DISTRIBUTION

W. H. Smith
Director

(15) N6onr-277(01)

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According to the terms of Contract N6onr-27701 (NR-083-004) the work to be performed by the Contract shall consist of the following:

1. The Contractor shall furnish the necessary personnel and facilities for, and, in accordance with any instructions issued by the Scientific Officer or his authorized representative shall

(a) conduct surveys and research, and analyze and compile data and technical information, prepare material for charts, manuals and reports, and foster the training of military and civilian personnel in the following fields of oceanography:

- (i) permanent currents;
- (ii) interaction of the sea and atmosphere, including wind waves, swell and surf;
- (iii) distribution of organisms;
- (iv) characteristics of the sea bottom and beaches;
- (v) tides, tidal currents and destructive sea waves; and
- (vi) physics and distribution of sea and terrigenous ice*;

and perform the following work in particular:

- (1) (Confidential)
- (2) collection of analyses of bathythermograph observations**; and
- (3) conduct of a wave measurement program in the Atlantic.

* Research in connection with relations between North Atlantic sea ice and Arctic weather was transferred to Task Order V of Contract N6onr-277 on May 15, 1949 and will be reported in a separate Periodic Status Report.

** The tabulation and filing of bathythermograph observations was transferred to Task Order VI of Contract N6onr-277 on May 15, 1949.

Accession For	MAIL ROOM	DDC FILE	INDEXED	FILED	DATE	BY	AVAILABILITY CODES	MAIL AND/OR SPECIAL	DIST

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This report contains a summary of the work carried out under Contract N6onr-27701 during April, May and June under the following headings:

Partial contents:

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Papers Published

Pollak, M. J., 1950: The water structure of the Brownson Deep. Trans. Amer. Geophys. Union, 31 (3):393-397, 3 text figs.

Spilhaus, A. F., A. Ehrlich, and A. R. Miller, 1950: Hydrostatic instability in the ocean. Trans. Amer. Geophys. Union, 31 (2):213-215, 4 text figs.

Stommel, H., 1950: Note on the deep circulation of the Atlantic Ocean. Jour. Meteorology, 7 (3): 245-246.

Papers Submitted for Publication

von Arx, W. S., 1950: Precise dead reckoning navigation. Jour. Inst. Navigation.

1950: An electrical method for measuring the velocity of ocean currents from a ship under way. Papers in Physical Oceanography and Meteorology, XI (3).

Redfield, A. C., 1950: The analysis of tides in narrow embayments, Papers in Physical Oceanography and Meteorology, XI (4).

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Operation CABOT

During June, the ATLANTIS and the CARYN were used in the multi-ship survey of the Gulf Stream. Fifteen members of our staff took part in the survey, either on our own vessels or on one of the four other vessels. Mr. Pollak was in charge of the group on ATLANTIS and Dr. Ketchum was the senior member of the scientific party of the CARYN.

Summary reports of the work carried out on both vessels have been submitted to the U. S. Navy Hydrographic Office, to the Naval Research Establishment in Halifax and to the U. S. Fish and Wildlife Service in Woods Hole.

Exchange of basic data between the various cooperating agencies has been completed, with the exception of the positions reported by the plane for the edge of the current.

The Loran positions are being rechecked and the track charts for the ATLANTIS, CARYN, ALBATROSS and NEW LISKEARD are being redrawn.

This work is being done by Mr. Worthington and Mr. Miller under the direction of Mr. Fuglister.

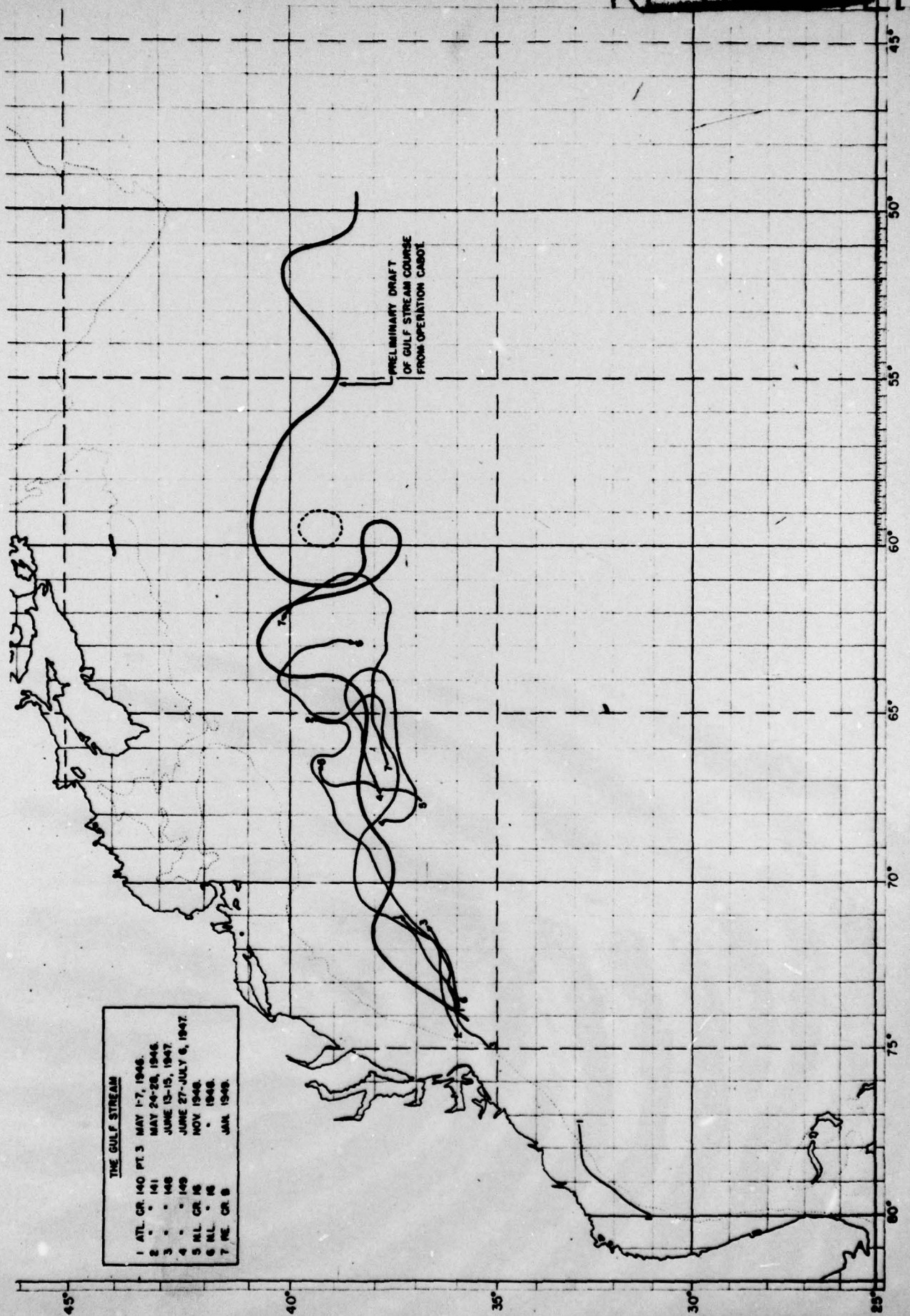
It has been our plan to get out a general report on the results of the cruise by the end of the summer and then somewhat more slowly to prepare more complete studies of selected topics. Events in Korea may cause this schedule to be revised, but we will not curtail examination of the data from the standpoint of undersea warfare. Rather it seems most important that field work of this type should be accelerated because of the many practical applications.

The main deficiency of the data collected by our vessels during Operation CABOT was due to failure of the recording Fathometers. Because of the heavy demands of the Bureau of Ships on our electronics technicians, there was not sufficient talent on either of our vessels to repair the Fathometers at sea. The instrument on ATLANTIS has been operating about 250 days a year for four years. It was thought that it would keep going a few more weeks. This proved to be a very optimistic estimate. On her return, a new instrument supplied by the Bureau of Ships was installed. On the CARYN the troubles were minor, but before they were corrected the supply of spare tubes had been exhausted.

Analysis of GEK data obtained during Operation CABOT has been started.

In Figure 1 the path of the inshore edge of the Gulf Stream, as observed during the early phases of the June survey,

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THE GULF STREAM	
1	ATL CR 140 PT 3 MAY 1-7, 1946
2	" " 141 MAY 24-28, 1946
3	" " 146 JUNE 13-15, 1947
4	" " 149 JUNE 27-JULY 6, 1947
5	NL CR 16 NOV 1948
6	NL " 16 " 1948
7	NE CR 8 JAN 1949

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is compared with the previous similar data. Arrangements have been made for Professor C.-G. Rossby to visit Woods Hole during September in order to work with these data. The diagram once again emphasizes the great difficulties one faces in attempting to describe the physical characteristics of the ocean by averaging spot observations secured over a considerable period of time. Two experienced navigators, returning from Bermuda towards the end of June, encountered north-south sets of 60 and 80 miles in 24 hours indicating that extreme meanders are possible within 300 miles of Cape Hatteras and that the first wave encountered in CABOT continued to develop.

Summer Program of ATLANTIS and CARYN

The Columbia University group under Dr. W. M. Ewing will use both vessels from July 5 to September 20. The main objective is to secure refraction profiles from Bermuda to Puerto Rico, Bermuda to Charleston and Bermuda to Newfoundland. However, two Gulf Stream crossings will be made on each of these lines, as well as on the well travelled Woods Hole-Bermuda section.

The GEK equipment has been left on ATLANTIS and an experienced man has been supplied to operate it. An attempt will be made to tow the electrodes both at the surface and at 300 feet, using an Isaacs depressor, so as to explore the velocity at the depth used in defining the Gulf Stream front on Operation CABOT.

Arctic Oceanography

On 5 May 1950, Messrs. M. J. Pollak and W. G. Metcalf returned from the winter cruise aboard the U.S.S. EDISTO (AGB-2). The oceanographic data from the cruise was processed at the Woods Hole Oceanographic Institution and a report completed by 5 June. In addition to discussing the ice and oceanographic data, this report commented on the general problem of polar oceanography. The recommendations towards a more efficient research program in those regions are summarized below.

1. Icebreakers should be assigned with oceanographic work as their prime mission.
2. Operational orders should be drawn up in conjunction with the scientists assigned to the cruise and should enable the scientist-in-charge and the commanding officer to make modifications en route as required by existing circumstances.

3. Adequate laboratory space must be made available on the main deck near the oceanographic winches.
4. Oceanographic winches and instruments should be modified or developed to insure efficient operation under Arctic conditions.

Mr. John F. Holmes, in conjunction with the 10th Rescue Squadron made several attempts to land on the Arctic ice pack out of Barter Island, Alaska, for the purpose of investigating the feasibility of this method of studying Arctic oceanography. One successful landing was made in a C47 plane and two in a helicopter. Subject to other commitments of the 10th Rescue Squadron, and in spite of the difficulties of ice landings, Mr. Holmes considers this method of Arctic investigation in ice covered areas practical. Mr. Holmes also took a complete unit of the Bristol Airborne Sea and Swell Recorder to Alaska where it was tested but no conclusive results were obtained.

Salinity Titrations and Calibrations of Thermometers

The following groups of salinity samples have been titrated:

U.S.S. EDISTO	40
ATLANTIS Cruise #157	200
ALBATROSS Cruises #30 and #31	1,200
ASTERIAS	40
U. S. Public Health Service	35
Miscellaneous	10

The new titrating installation in a constant temperature room continues to facilitate this work and to improve the accuracy. Three full-time technicians have been thus employed under the supervision of Mr. Pollak.

The following thermometers have been received for calibration:

U. S. Coast Guard	1
Bermuda Biological Station	14
W.H.O.I.	5

Statements of examination have been issued for 14 thermometers.

This work has been carried out by Mr. Pingree under the supervision of Mr. Bumpus.

Wave Studies

Analysis of the wave data secured off Bermuda during the winter in cooperation with NRL has progressed steadily.

In part assisted by a grant from NRL, Dr. Seiwel has undertaken an experimental study of correlogram analysis of several artificially generated series of data. Both hand and machine procedures for computation of autocorrelation coefficients were employed. The large amount of computation required for the investigation was under the supervision of Mr. Thomas C. Duke and Mrs. Mary G. Hunt.

Four types of situations were studied:

1. A sine wave combined with increasing amounts of random fluctuations.
2. Two or three sine waves of different characteristics in combination.
3. A variety of autoregressive series.
4. Autoregressive series in combination with cosine waves of various amplitudes and periods.

In all, some 45 series of synthetic data were examined. Comparison between the theoretical results and those achieved by computations were made and the effects of the length of the series were studied. These results will be reported early in August at a symposium in Berkeley. They will enable the interpretation of correlogram analyses of natural time series to be undertaken with increased confidence.

Vertical Movement of Heat and Momentum

Detailed studies of the formation of a thermocline have been sadly neglected in oceanography. In the field work it has usually seemed more profitable to keep the ship moving so as to cover as wide an area as possible, rather than to remain with a given water mass and observe what happens to it during the time available. A notable exception was the study of diurnal warming carried out by Mr. Woodcock during a period of about a month in the central part of the Gulf of Mexico in the spring of 1942. Mr. Henry Stommel has recently restudied these data with the idea of undertaking a similar observational program. However, it was decided first to observe the development of thermoclines in a lake.

In a lake, one can use a rowboat rather than a ship, and the problem of anchoring continuously recording instruments and markers is much simplified. On the other hand, the situation is complicated by the necessity of return flow of the wind induced currents.

Field observations were commenced on Ashumet Pond (Cape Cod) in April. The lake is roughly circular and almost a mile in diameter. Beginning in May bathythermograph lowerings were made at nine different stations four times each day. It is planned to continue this detailed survey during the course of a year.

Current observations are also being made at a number of stations as often as practicable. A variety of methods has been tried, and for the present, buoyed current crosses seem to be the best method. A variety of special experiments are being made from time to time, such as towing many junction thermocouples about the pond to detect micro-structure, etc. A complete set of meteorological observations is available from nearby Otis Field; and supplementary weather data are recorded at the pond by automatic means. The result of the survey will be a very detailed thermal history of the pond from which we hope to be able to extract quantitative information on the transfer of heat and momentum across a natural water surface. It is still too early to assess this primary aspect of the program.

In the meantime, several interesting results are already available. One is a series of speeded-up motion picture films made of the pond surface. They seem to show that during the warming period the long slicks and lines of foam that are lined up- and down-wind are not related to the cellular structure of the wind, nor to the cellular convection patterns of the epilimnion, nor to internal waves. Thus, we are forced to conclude that these particular streaks are not the same kind of thing reported by Woodcock, Langmuir, or Ewing, respectively, but something quite different. The exact physical process which is involved in the formation of these streaks is still unknown, but seems to be confined to a thin skin of water at the surface.

The series of visual observations of streaks under a variety of wind and heat flux conditions at present exceeds 200. From these it seems that the lines form under much lower wind velocities than reported by other investigators.

Other interesting results are the tilting of the thermocline under the stress of the wind and the fact that it becomes thinner the more deeply it is depressed. The sudden formation of the thermocline in the spring is also peculiar. It is hoped that the data will make possible a test of the theory of Munk and Anderson.

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PERSONNEL

<u>ASSIGNMENT</u>	<u>NAME</u>	<u>TITLE</u>	<u>TOTAL MAN DAYS*</u>
GENERAL TASK ASSIGNMENT	C. O'D. Iselin**	Director	47
	A. C. Redfield	Associate Director	
	F. C. Ryder	Assistant to the Director	
	Jeanne M. Backus	Secretary	
HYDROGRAPHIC OBSERVATIONS AND ANALYSES	Dean F. Bumpus	Oceanographer	465
	Arnold H. Clarke	Research Assistant	
	N. T. Corwin	Hydrographic Technician	
	F. C. Fuglister	Physical Oceanographer	
	Carlyle Hayes	Hydrographic Technician	
	B. H. Ketchum	Marine Microbiologist	
	John F. Holmes	Research Associate in Physical Oceanography	
	Frank J. Mather III	Research Associate	
	Donald Martineau	Research Assistant	
	W. G. Metcalf	Physical Oceanographer	
	A. R. Miller	Physical Oceanographer	
	Robert Plante	Research Assistant	
	Martin J. Pollak	Physical Oceanographer	
	L. V. Worthington	Physical Oceanographer	
CURRENTS AND WAVES	Louise Allen	Laboratory Helper	666
	Arnold Arons	Associate in Physical Oceanography	
	Ruth Barker	Secretary-Technician	
	Barbara Bunker	Technician	
	Richard Dimmock	Technician	
	Louise Dudley	Secretary-Technician	
	Thomas Duke	Research Assistant	
	H. B. S. Hall	Technician	
	Mary G. Hunt	Statistical Technician	
	John Hurley	Hydrographic Technician	
	Arthur Klebba	Research Associate	
	Phyllis MacDermid	Secretary-Technician	
	A. Murphy	Laboratory Helper	
	H. R. Seiwel	Physical Oceanographer	
	Henry Stommel	Physical Oceanographer	
	W. S. von Arx	Physical Oceanographer	
	Dorothy Yarnold	Laboratory Helper	
PHOTOGRAPHY AND DRAFTING	F. A. Bailey	Draughtsman	197½
	D. M. Owen	Photographer	
	G. G. Pasley	Draughtsman	
	Claude Ronne	Photographer	
	Eva Shelnut	Draughtsman	
	John Stimpson	Draughtsman	

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<u>ASSIGNMENT</u>	<u>NAME</u>	<u>TITLE</u>	<u>TOTAL MAN DAYS*</u>
MISCELLANEOUS SHOPWORK AND LABORATORY ASSISTANCE			223

- * Man Day consists of 8 working hours.
** Time not included in figures for man days.

GRAND TOTAL 1,598½

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